Relative Timings of Structures and Mesozoic-Cenozoic Intrusions in the Sand Springs Range, Nevada

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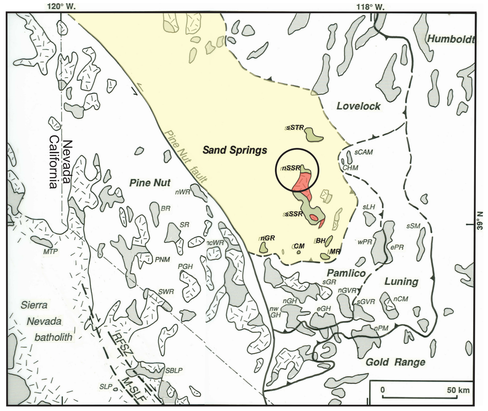
Objectives:

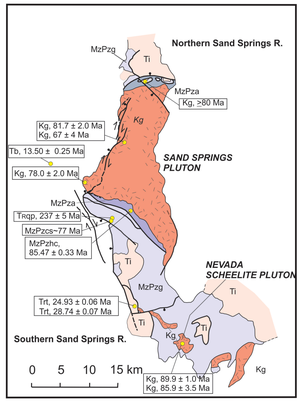
- To create a detailed geologic map at a 1:8000 scale.
- To document slip on map area faults.
- To document the orientations of map-scale folds.
- To construct a tied grid of cross sections to model the subsurface in the future.
- To revise the currently accepted sequence of events based on field findings.

Methods:

- Completed field mapping over a two week period.
- Extrapolated mapped contacts using satellite imagery.
- Measured orientation of planes using a Brunton compass.
- Used measured surface data to create tied cross section grid.
- Constructed stereonets to show deformation phases.
- Analyzed thin sections to complete rock descriptions.

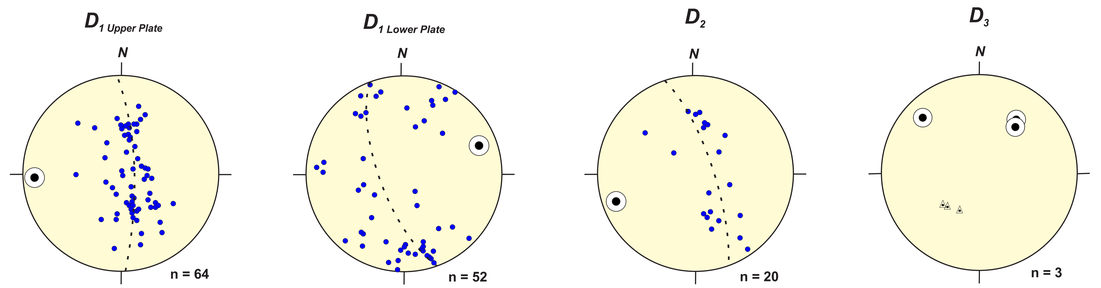


Regional Map showing the location of the northern Sand Springs Range (nSSR) within the Sand Springs Assemblage of the Luning-Fencemaker Fold and Thrust Belt in western Nevada.



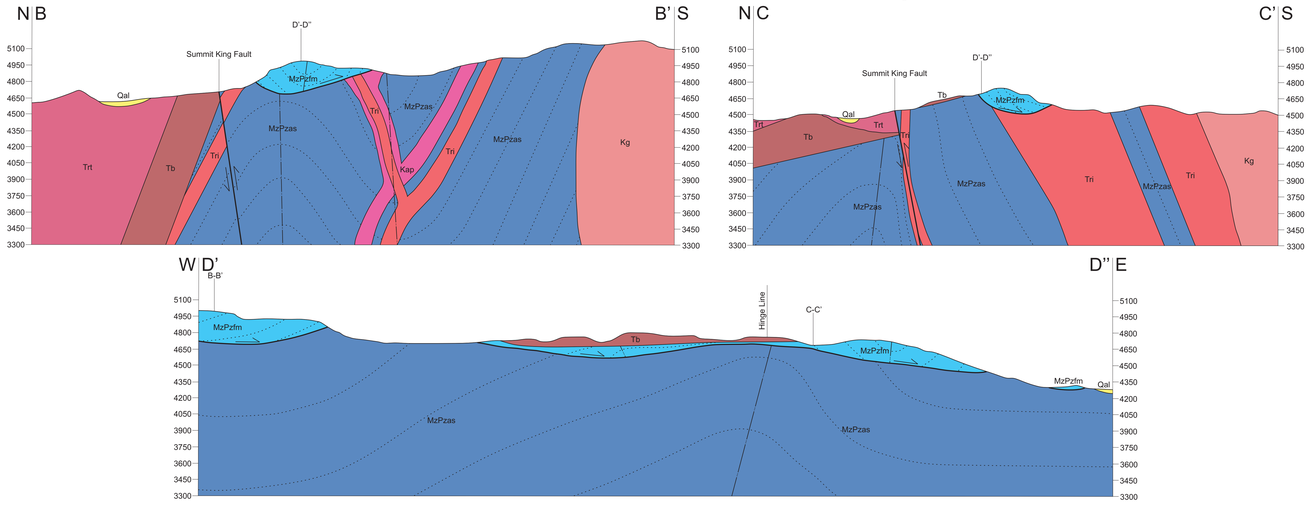
Map of the Sand Springs Range showing location and age of samples dated. Figure courtesy of Joseph Satterfield.

Stereonets Illustrating the Orientation of Structures Related to Deformation Events



D_1 deformation created the metamorphic foliations of the MzPzfm, MzPzas, and MzPzqs. The D_1 stereonets show the difference in orientation of the foliations within the MzPzfm (upper plate) and the MzPzas and MzPzqs (lower plate). The D_2 steronet shows the orientation of folds created by the second stage of deformation which have axial planes trending NE-SW. The D_3 stereonet shows the orientation of broad folds which have axial planes generally trending NW-SE. D_3 data courtesy of Joseph Satterfield.

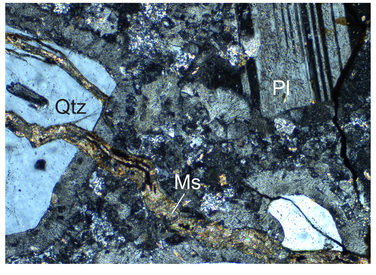
Cross Sections of the Eastern Half of the Map Area



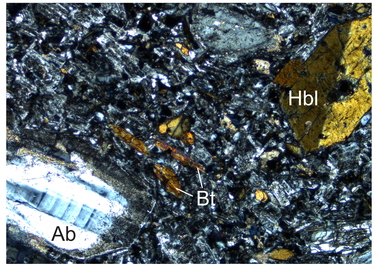
Scale 1:4000

Eastern half of a tied grid of cross sections at the same scale as the geologic map. B-B' and C-C' are views to the east and show the D2 folding of the thrust faults and of the D1 metamorphic foliation of MzPzfm and MzPzas. These sections also show that the sills intruded along foliation planes, that Kap pooled at the central klippe thrust fault, and the separation of the Summit King Fault and how it cross-cuts the youngest units in the map area (Tb and Trt). D'-D'' is a view to the north showing the broader D3 folds of the thrust faults and of the D1 metamorphic foliation of MzPzfm and MzPzas. No vertical exaggeration.

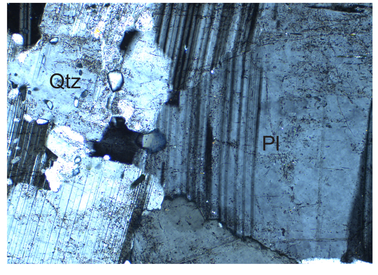
Thin Sections of Igneous Units Critical to Relative Timing of Structures



081015-2 Tri 100X Mostly quartz matrix with larger quartz, plagioclase, and muscovite crystals. The overall aphanitic texture of this rock is an indication of its Tertiary age, which constrains the age of the thrust fault it cross-cuts.



080915-2 Trt 100X The aphanitic quartz and albite matrix of this intrusion are indicative of its Tertiary age which constrains the age of the Summit King Fault which cross-cuts it.



081815-1 Kap 100X The 1-3 mm quartz and plagioclase crystals in this section are indicative of the Cretaceous age of this intrusion which constrains the age of the thrust below which it pools.

View to the east of the eastern klippe. At least five light-colored Tri sills can be seen approaching but ultimately terminating just below the thrust (thick black line) at the base of the cliff-forming MzPzfm. Photo courtesy of Joseph Satterfield.

View to the northeast of the eastern klippe showing a light-colored Tri sill cutting across the thrust (black line, dashed where approximately located) at the base of the cliff-forming MzPzfm. Photo courtesy of Joseph Satterfield.

Jacob Jarvis and Sean Czarnecki at the end of the final day of field work, August 20, 2015. Photo courtesy of Joseph Satterfield.

Acknowledgements:

The authors would like to thank the Southwest Section of the American Association of Petroleum Geologists for the Undergraduate Research Grant, Angelo State University for the Undergraduate Faculty Mentored Research Grant, Solaro Inc. for allowing us to access their property, and Middlegate Station for their hospitality.

Conclusions:

- Basalt previously mapped as Cretaceous is actually Tertiary, which constrains the age of the high-angle faults which cross-cut it.
- Tertiary sills stop at or cross-cut folded low-angle faults, indicating that the age of these faults is Tertiary or older.
- The pooling of a Cretaceous sill at the central low-angle fault constrains the age of low-angle faults to Cretaceous or older.
- These findings lead to the following revised Sequence of Events interpretation:

1) Trqp plutons intrude protolith of MzPzas.
2) D1 metamorphoses and deforms Trqp and MzPz protoliths into MzPzqs, MzPzas, and MzPzfm metamorphic tectonites. D1 folds formed.
3) Thrust fault transports upper plate above lower plate, creating klippen.
4) D2 folds foliation in MzPzqs, MzPzas, and MzPzfm and the thrust faults in a NE-SW orientation.
5) D3 refolds foliation in MzPz units and the thrust faults in a NW-SE orientation.
6) Kg pluton passively intrudes MzPz units.
7) Kdi and Kap sills intrude MzPzas and MzPzfm primarily along metamorphic foliation. Kap pools at central klippe thrust fault.
8) Tri sills intrude MzPzas, MzPzfm, and Kap primarily along metamorphic foliation and often stop at or cross-cut thrust faults.
9) Tb and Trt deposited atop erosion surface. Tb pools in klippe anticlines.
10) Red Top Fault cross-cuts metamorphic units, thrust faults, Cretaceous intrusions, and Tertiary extrusives.
11) Summit King Fault cross-cuts MzPzas and Tertiary extrusives.